NON-PUBLIC?: N
ACCESSION #: 9311030377
LICENSEE EVENT REPORT (LER)

FACILITY NAME: Braidwood 2 PAGE: 1 OF 6

DOCKET NUMBER: 05000457

TITLE: Reactor Trip Due to LO-2 Level in 2D Steam Generator Due to O-ring Failure in Feedwater Regulating Valve Positioner
EVENT DATE: 10/03/93 LER #: 93-007-00 REPORT DATE: 10/26/93

OTHER FACILITIES INVOLVED: None DOCKET NO: 05000

OPERATING MODE: 1 POWER LEVEL: 100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION:
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:
NAME: T. Eichhorn, System Engineering TELEPHONE: (815) 458-2801 ext 2400

COMPONENT FAILURE DESCRIPTION:
CAUSE: X SYSTEM: SJ COMPONENT: INCTRL MANUFACTURER: B045
REPORTABLE NPRDS: YES

SUPP
EMENTAL REPORT EXPECTED: NO

ABSTRACT:

Prior to the event, a Nozzle Flow High/Low alarm occurred on the 2D S/G, all conditions appeared normal. Approximately 30 seconds later the Nozzle Flow High/Low alarmed again, followed immediately by a Steam/Feed Flow Mismatch alarm. It was then noted that turbine load had increased by approximately 50 MWe. Digital Electro-Hydraulic Control was taken to manual in an attempt to stabilize the plant. At 0138 on 10/03/93, the Unit tripped due to LO-2 level in the 2D S/G. The cause of this event was a combination of Equipment Failure and Management/Quality Assurance Deficiency. The O-rings in the valve positioner hardened due to normal aging in a moderate heat environment. The corrective actions are: all four positioners on the Unit 2 FWRVs were replaced, A Preventative Maintenance program will be established for the Unit 2 FWRV positioner

internal components every refueling outage. A routine elastomer changeout on valve positioners will be investigated. A routine instrument air filter cleaning/changeout program will also be investigated. The valve positioners on the 2FW046A through D valves will be inspected during the next Unit 2 refuel outage. There has been a reportable event involving a FWRV at Braidwood. A different valve and failure mode was involved, therefore there is no adverse trend.

END OF ABSTRACT

A. PLANT CONDITIONS PRIOR TO EVENT:

UNIT: BRAIDWOOD 2; EVENT DATE: october 3, 1993;
EVENT TIME: 0138; REACTOR MODE: 1 - Power Operation; POWER LEVEL: 100%
RCS AB! TEMPERATURE / PRESSURE: 580 DEGREES F/2235 PSIG

B. DESCRIPTION OF EVENT:

There were no components degraded prior to the event which affected the severity of the event.

Prior to the event, plant operators responded to a Nozzle Flow High/Low alarm on the 2D S/G. The alarm was acknowledged and reset, all conditions appeared normal. The alarm had toggled on a high flow signal. Approximately 30 seconds later the Nozzle Flow High/Low alarmed again, this time on low flow and followed immediately by a Steam/Feed Flow Mismatch alarm. It was then noted that turbine load had increased by approximately 50 MWe. Digital Electro-Hydraulic (DEH) Control was taken to manual in an attempt to stabilize the plant on the premise that DEHC was the cause of the perturbation.

Level in the 2D S/G could not be stabilized, and at 0138 on 10/03/93, the Unit tripped due to LO-2 level in the 2D S/G. The plant was stabilized in Mode 3. All plant systems responded normally following the trip.

It was found that the 2FW540 Feedwater Regulating Valve (FWRV) had failed shut and would not respond to operator demand to open via the manual controller on the Main Control Board. Field observation saw the Control Air pressure to the valve positioner varying from 3 to 15 psig with no valve movement or controller output.

Operator actions neither increased or decreased the severity of the event.

At 0237 the appropriate NRC notification was made via the ENS phone system pursuant to 10CFR50.72 (b) (2) (ii).

On 10/04/93 the failed positioner was replaced in the field with a new positioner.

This event is being reported under the requirements of 10CFR50.73 (a) (2) (iv) - any event or condition that resulted in manual or automatic actuation of any engineered safety feature (ESF), including the reactor protection system (RPS).

C. CAUSE OF EVENT:

The cause of this event was a combination of Equipment Failure and Management/Quality Assurance Deficiency. There were no gross mechanical failures which would cause the 2FW540 FWRV positioner to fail to operate. The positioner was completely disassembled and reassembled. No internal parts were found to have failed. However, three items were found which could have caused the FWRV valve to fail shut:

1) All the O-rings in the positioner were hardened and brittle. There was a significant amount of leakage past the O-rings.

2) The filter for the Nozzle Chamber, which controls movement of the Relay Center Structure, appeared to be plugged. When the old filter was in the air circuit and the Relay Center Structure was perturbed, it oscillated continuously without dampening. When a new filter was installed in the air circuit and the Relay Center Structure perturbed, it initially oscillated but dampened out over a 5 to 10 second time period.

3) The 02 valve, which is used as a balancing force in the relay assembly was found to have burrs and slightly raised metal on the valve stem where it passed through the retaining washer. These burrs in combination with residue on the parts caused the valve to stick in the down position. After some lubrication was applied to the valve stem, the valve did not stick in the down position but it was still stiffer than a new valve.

A review of work request history did not reveal any maintenance repair/replacement action on the Unit 2 FWRV positioners since, original construction. The Vendor manual recommends specific preventative actions on an annual basis. The lack of preventative maintenance was the result of a Management/Quality Assurance Deficiency.

The Unit 1 FWRV positioners and both the Unit 1 and 2 FWRV Bypass valve controllers are a completely different model of Bailey positioner (Model #5321030A18). This different model is of a completely different design than the Unit 2 FWRV positioner and can not fail in the manner the Unit 2 positioner failed.

Based on the above, it is concluded that the following scenario occurred:

1) The O-rings in the valve positioner hardened due to normal aging in a moderate heat environment.

2) When the O-rings hardened, they could not seal pressure into the various control chambers inside the valve positioner Relay Assembly. This caused the Relay Center Structure to begin to hunt.

3) The hunting caused the 02 Valve Stem to wear. This wear is in addition to the normal wear after 7 to 8 years of use.

4) The hunting also caused more air to be processed through the Nozzle Chamber filter/orifice, which controls movement of the relay center structure. Since the filter was never changed out, it became plugged. This removed some dampening effect, which aggravated the hunting.

5) On Sunday 10/3/93, the final oscillation pushed the 02 valve down and it hung up. This means that the 02 Valve Exhaust Valve was continuously open and no pressure could build up in the 02 Valve Chamber. With the Nozzle Chamber filter plugged, there was no returning force on the Relay Center Structure to counter balance the Reference Supply Pressure.

6) Due to the Reference Supply pressure, the Relay Center Structure could not move up to close off the 01 Valve Exhaust port, the FWRV positioner output pressure bled to zero, and the FWRV valve shut.

D. SAFETY ANALYSIS:

This event had no effect on the safety of the plant or the public. All safety systems operated as designed. The auxiliary feedwater (AF) system was available to auto start and restore S/G levels as designed.

Under the worst case condition of a loss of FW event occurring at 100% power there would still be no effect as this is enveloped in Section 15

of the Updated Final Safety Analysis Report. The LO-2 SG level setpoint ensures that the reactor is taken sub-critical while sufficient inventory is available in the SG to provide for initial decay heat removal. The automatic initiation of one of the two redundant AF pumps provides adequate water inventory addition to re-establish SG levels to normal and remove long term decay heat without significant impact to the temperature, pressure, and inventory of the rcs. Both AF pumps were available and initiated as designed during this event.

E. CORRECTIVE ACTIONS:

1) All four positioners on the Unit 2 FWRVs were replaced prior to the unit startup.

2) A Preventative Maintenance program will be entered to inspect/repair/replace the Unit 2 FWRV positioner O-rings, 01 valve, 02 valve, and filters every refueling outage. The Vendor Manual recommends this be done on an annual basis, but an 18 month refueling outage frequency will be an adequate timeframe to inspect these positioners. Industry data reviewed in the NPRDS database shows an average life of 40 months before failure for these positioners, therefore indicating that an eighteen month inspection frequency is conservative. This will be tracked to completion by action item 457-180-93-00701.

3) Braidwood Station has had a similar problem of elastomer failure due to "compression set" in other areas, most notably the Heater Drain and FW009 Nitrogen solenoids. Braidwood will investigate the establishment of a routine elastomer changeout on valve positioners. This will be tracked to completion by action item 457-180-93-00702.

4) Braidwood Station will survey valve positioner air filters throughout the plant in the Instrument Air System (IA) to determine the cleanliness of the filters in the IA system. With this as a basis, the Station will investigate the establishment of a routine filter cleaning/changeout program. This will be tracked to completion by action item 457-180-93-00703.

5) The 2FW046A-D elastomers on the positioner operating spool valve were checked on 10/7/93, and while they were beginning to exhibit a slight compression set, they were still flexible and serviceable. The valve positioners on the 2FW046A through D valves will be inspected for degraded elastomers during the next Unit 2 refuel outage to ensure that they will function during the startup. This

will be tracked to completion by action item 457-180-93-00704.

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F. PREVIOUS OCCURRENCES:

Two reportable events have occurred at Braidwood involving a FWRV failure. No adverse trends exist. The previous event involved different FWRV and failure mode, the corrective actions addressed in that event were different. This event involved operating the positioner until it incurred age-related wear/failure.

LER 2-88-014; Unit 2 Reactor Trip Due to Low Water Level Caused by Erratic Operation of the Main Feedwater Regulating Valve - this event involved failure of valve 2FW520. This event was attributed to startup problems.

A review of 55 failure records from throughout the nuclear industry concerning Bailey Model #AP412000 or #AP412100 positioners from the NPRDS Data Base revealed that over the last three years there were 25 instances of Model AP4 positioner failure on various systems due to "normal wear", "high temperature", "normal ageing", "dirty filters", etc. The average age of these components at failure was 40 months. The Braidwood Unit 2 positioners were on the order of 70-80 months old.

G. COMPONENT FAILURE DATA:

MANUFACTURER NOMENCLATURE MODEL NUMBER MFG PART NUMBER

Bailey Controls Positioner AP4 AP412000

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Commonwealth Edison
Braidwood Nuclear Power Station
Route #1, Box 84
Braceville, Illinois 60407
Telephone 815/458-2801

October 29, 1993
BW/93-0269

U. S. Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555

Dear Sir:

The enclosed Licensee Event Report from Braidwood Generating Station is being transmitted to you with the requirement of 10CFR50.73 (a) (2) (iv) which requires a 30-day written report.

This report is number 93-007, Docket No. 50-457.

K. L. Kofron
Station Manager
Braidwood Nuclear Station

KLK/AJS/dla

Encl: Licensee Event Report
No. 50-457/93-007

cc: NRC Region III Administrator
NRC Resident Inspector
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